

Balloon Program Office Code 820

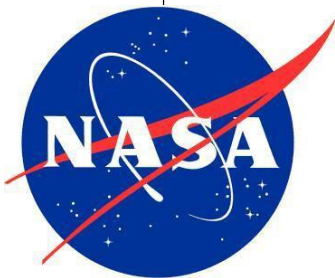
BITSE GN₂ Purge Procedure

**THIS PROCEDURE CONTAINS
HAZARDOUS OPERATIONS**

Document Owner: Jeffrey Newmark

**Effective Date
July 2019**


820/Balloon Program Office



**National Aeronautics and
Space Administration**

Goddard Space Flight Center
Wallops Flight Facility
Wallops Island, Virginia 23337


Authored by:

 Digitally signed by Andrew Hynous
Date: 2019.07.31 09:31:23 -04'00'

Andrew Hynous **Date**
820/Mission Operations Manager

Reviewed by:

Brian Bath
(affiliate)

 Digitally signed by Brian Bath (affiliate)
Date: 2019.07.31 15:17:29 -05'00'

Brian Bath **Date**
CSBF/Safety

Reviewed by:

CAROLYN
TURNER  Digitally signed by
Date: 2019.07.31

Carolyn Turner **Date**
803/Ground Safety Deputy

Reviewed by:

DAVID
GREGORY  Digitally signed by
DAVID GREGORY
Date: 2019.08.01 15:24:19 -04'00'

David Gregory **Date**
820/Deputy Chief

Approved by:

Debora Fairbrother **Date**
820/Chief

THIS PAGE LEFT INTENTIONALLY LEFT BLANK.

Table of Contents

| | |
|---|----|
| Contents | 4 |
| 1 PURPOSE | 5 |
| 2 SCOPE | 5 |
| 3 DEFINITIONS/ACRONYMS | 5 |
| 4 RESOURCE REQUIREMENTS | 5 |
| 5 EQUIPMENT REQUIREMENTS | 5 |
| 6 TRAINING REQUIREMENTS | 6 |
| 7 SAFETY INFORMATION | 6 |
| 8 REFERENCES | 9 |
| 9 QUALITY ASSURANCE | 10 |
| 10 IMPLEMENTATION | 11 |
| 10.1 BITSE Ground Purge Procedure | 11 |
| 10.2 BITSE Launch Pad Purge Procedure | 12 |

1 **PURPOSE**

The purpose of this document is to describe the procedure used by the BITSE team to purge the optics sections of the BITSE coronagraph with dry nitrogen gas.

2 **SCOPE**

This document covers the use of GN₂ as a purging medium during ground and launch operations of the BITSE telescope during ballooning campaigns.

3 **DEFINITIONS/ACRONYMS**

- BPO Balloon Program Office
- CSBF Columbia Scientific Balloon Facility
- GSE Ground Support Equipment
- HAZOP Hazardous Operation
- OSS Operations Safety Specialist
- PPE Personnel Protective Equipment

Supply Pressure Circuit – Sometimes called the High-pressure supply circuit. This term refers to all portions of the Pneumatics system that are not regulated. This specifically is the portion of the system that sees the highest pressure when charged. It typically will contain the reservoir tank and its associated components, such as transducers, tubing, fill/vent valves, check valves and filters. These systems are typically operated at 3,000 to 5,500 psi in flight mode.

Regulated-pressure circuit (RPC) - This term shall refer to any portion of the systems that are downstream of the main pressure-reducing regulator. It will typically include such components as; relief valves, transducers, check valves, control valves, transfer valves, manifolds, tubing, and possibly additional pressure reducing regulators. These circuits are typically operated at 15 – 1,000 psi.

4 **RESOURCE REQUIREMENTS**

- OSS certified for pressure systems
- System operator (Only personnel trained in handling pressure systems and knowledge of system being pressurized are authorized to perform this hazardous procedure). OSS will verify certification.

5 **EQUIPMENT REQUIREMENTS**

High purity 4.8-grade (or better) Nitrogen gas with a certified regulator. One ~300 CF bottle per day. Liquid nitrogen boil off may be used instead.

Personal Protective Equipment (PPE):

- Safety glasses or full-face shield (ANSI-std-z87.1) will be worn while pressurizing.
- Ear protection (ANSI S3, 19-1974) will be worn during venting operations.

6 **TRAINING REQUIREMENTS**

- The Operations Safety Specialist (OSS) must be familiar with the pressurized systems and/or be thoroughly briefed prior to operations.
- The operator must have a working knowledge of the pressure systems.
- System operator must have high-pressure operation certification.

7 **SAFETY INFORMATION**

CAUTION

This procedure contains operations, which are considered HAZARDOUS, and thus requires an OSS in addition to the system operator. The OSS must be an independent observer and shall not perform or assist in the performance of any hazardous operation.

Personnel working in the area should be informed that hazardous pressure operations are going to be conducted. The payload shall be oriented at all times such that, if a fast vent or bottle rupture were to occur, the output will not injure personnel.

CAUTION

During the hazardous portions of the operation, only personnel directly involved with the hazardous portions of the operation are permitted access to the payload and must wear the proper PPE.

- 7.1. For multiple operations, no hazard areas will be permitted to overlap each other.
- 7.2. Prior to beginning a hazardous operation, the OSS shall define a hazard area that will contain all components of the article during assembly, including liquid spills.
- 7.3. Under direction of the OSS, the hazard area shall be cleared of nonessential personnel prior to beginning of pressurization operations.
- 7.4. Any facility where personnel may inadvertently enter into a hazard area must be clearly identified prior to beginning pressure operations. Door identification shall prevent personnel from entering into the hazard area while permitting personnel to exit at any given time.
- 7.5. If a hazardous operation is being performed, the OSS or operator doing the operation shall conduct a safety briefing prior to any operation being performed. The briefing will include all essential personnel involved in the hazardous operation. The briefing shall cover all details of the operation, specify procedures to be used, and ensure clear understanding of the hazardous operation about to be performed and hazards involved.
- 7.6. Once the procedure is completed and the hazard is safeguarded, the technician and the OSS shall indicate an "All Clear" status that the article is now in the safe condition.
- 7.7. All completed procedures must be collected and reviewed by the OSS for safety deviation.
- 7.8. Special high-pressure Requirements:

- 7.8.1 Inform any personnel who must work in the area that hazardous and possible high-noise operations are going to be conducted.
- 7.8.2 The flight hardware, GSE, and environment test equipment used in this procedure are extremely sensitive to mishandling. Mishaps, involving hardware and test equipment, could result in costly equipment repair or replacement. The utmost care shall be used to minimize the risk of damaging the flight hardware, GSE, and environment test equipment. Proper ESD precautions shall be followed.
- 7.8.3 Cognizant personnel, prior to pressurization, shall inspect all pressure vessels. Pressure vessels that show signs of damage will not be pressurized.
- 7.8.4 Pressure hoses must be secured utilizing rope or hose tethers to prevent whipping of the line if the fitting should fail. Hose tethers must be secured tightly to hoses. Long lengths of hose must be secured every 6 feet with sand bags or hose tethers.
- 7.8.5 Compressed gas cylinders will be secured to prevent tipping. All 6,000 psi bottles must be moved using a compressed gas cylinder dolly.
- 7.8.6 After system stabilization, access to the system shall be restricted to the minimum number of essential personnel.
- 7.8.7 Under no circumstances shall pressurization be performed exceeding the vendor rated MOP of any component.
- 7.8.8 Caution must be exercised when working with compressed gas to prevent system failures caused by rapid expansion and heating.
- 7.8.9 Each hose assembly (hose and two end fittings) must be certified and have a metal or plastic tag attached containing the certification information.
- 7.8.10 Make a final check before applying pressure to determine that all lines are connected and that all fittings are tight.
- 7.8.11 Close valve and bleed all gas from lines and test bodies before disconnecting fittings.
- 7.8.12 To verify compliance with GSFC safety requirements, equipment and systems shall be subjected to a safety review prior to their first operation and are prohibited from being operated without formal approval from the OSS. The owner/operator of the system shall notify the OSS of any operating system configuration change that significantly alters the safety documentation for review and approval. The following documentation is required for review of the system: Functional system diagrams or schematics; components list documenting appropriateness; operating procedures; operator training; list of discharge valves or ports; maintenance requirements; pressure relief valve size analysis under worst case failure conditions; and Oxygen Deficiency Hazard (ODH) analysis, under worst case failure conditions.

7.8.13 Pressure vessels shall conform to PVS requirements documented in NPD 8710.5, GPR 8710.3, and NASA-STD-8719.17. All specifications for custom fabricated equipment shall be reviewed by safety as set forth in this document.

7.8.14 Safety Hazard Guidelines: Hazards associated with asphyxiation or ODH, potentially high-pressures can jeopardize the safety of personnel and cause damage to flight hardware and test equipment. Equipment design and handling procedures should eliminate hazards wherever possible or mitigate risks to an acceptable level.

Asphyxiation: Personnel shall not enter or occupy an area where the oxygen level is less than 19.5% by volume. An ODH assessment shall be conducted whenever an area containing enough displacing gas to pose a potential oxygen deficiency is established or modified, and wherever used, stored, or dispensed. Areas determined to have a potential for oxygen deficiency shall be identified by signage, at all entrances. Visitors or temporary workers who have not had ODH training may enter a posted ODH area ONLY after the ODH hazard has been explained to them by personnel familiar with the hazards in the area. Fixed Oxygen monitors shall alarm at an oxygen concentration of 19.5% and have a siren and flashing strobe light. The siren and strobe shall be distinctive from other alarms in the immediate area, such as fire alarms. Oxygen monitors shall be installed with consideration of the buoyancy of the displacing gas. Fixed oxygen monitors shall not be disabled except by qualified personnel. Portable oxygen monitors shall be readily accessible to ODH designated areas. Portable oxygen monitors will alarm at 19.5% oxygen. The organization issuing personal oxygen monitors is responsible for compliance with this requirement.

Table 1 - Recommended Oxygen Monitor Placement

| GAS | TEMPERATURE | LIGHTER OR HEAVIER THAN AIR | MONITOR PLACEMENT |
|-----------------|-------------|-----------------------------|------------------------|
| Argon | Any | Heavier | 2 – 3 ft. from Floor |
| Carbon Dioxide | Any | Heavier | 2 – 3 ft. from Floor |
| Carbon Monoxide | Any | Similar | 4 – 6 ft. from Floor |
| Helium | Any | Lighter | 2 – 4 ft. from Ceiling |
| Hydrogen | Any | Lighter | 2 – 4 ft. from Ceiling |
| Hydrocarbons | Any | Heavier | 2 – 3 ft. from Floor |
| Methane | Any | Lighter | 2 – 4 ft. from Ceiling |
| Nitrogen | Any | Heavier | 4 – 6 ft. from Floor |

Oxygen Enrichment: At temperatures less than 82 K, metal surfaces will condense oxygen and form enriched air which can drip and form pools. Liquefied air enriches to 50% O₂. Nitrogen, which has a lower boiling point than oxygen, will evaporate first, leaving an oxygen enriched condensate on the surface. These surfaces will readily ignite and support combustion. Insulate lines whenever possible, use heaters, drip pans. No smoking, open flames, or ignition sources. Try to eliminate combustible material in the vicinity of systems.

Pressurization: All potential trapped volumes must have over pressure protection. Vacuum vessels must have over pressure protections as well. Cold leaks can build up pressure when the vessel warms. Relief valves protect Dewars from over pressurization.

Ice Buildup: Ice build-up on un-insulated areas can cause damage to surrounding equipment by making sensitive materials brittle and adding additional weight to supports. Ice buildup can block relief valves or access to critical valves. Ice buildup can freeze O-rings and compromise insulating vacuums. Insulate lines whenever possible, use heaters, and extending relief valves away from cold lines.

Ice Plugs: Frozen plugs can form in Dewar plumbing if the system is exposed to air. Moisture in air can also block lines. The smaller the vent line the more susceptible to plugging. Sometimes fill or vent lines are also the path to relief valves. Plugs in these lines could potentially prevent the vent valves, as well as pressure relief valves, from releasing pressure from the Dewars vaporizes. Over time, this will result in a pressure buildup that can cause structural failure of the Dewar. Any valves that lead to ambient air should be kept closed as much as possible and only be opened when required by procedure. Purge transfer line prior to inserting it into cold Dewar. Use check valves or extended length tubes on vents normally open to air.

Dewar Handling: A standard liter storage Dewar represents a possible tipping hazard and shall be moved by pulling on the handles on the side of the vacuum shell and not by the top ring. Handle gently - sloshing can move liquid to warmer regions of the Dewar and cause pressure spikes. Inspect wheels prior to moving. Wear proper shoes. Never lay a Dewar on its side. Use a lift gate or loading dock when loading or unloading from a truck. Dewars must be clearly labeled with contents. Do not make assumptions about an unlabeled Dewar.

Personal Protective Equipment (PPE): Appropriate PPE is required when handling, transferring, or working with high-pressure. If personnel are within an established exclusion zone, as determined by Project or Occupational Safety, PPE is required regardless of activity. PPE should be selected based on the specific material to be used to prevent material compatibility issues.

8 **REFERENCES**

- NPD 8710.5 NASA Policy for Pressure Vessels and Pressurized Systems
- NASA-STD-8719.17 Requirements for Ground-Based Pressure Vessels and Pressurized Systems (PVS)
- GPR 8710.3 Certification and Recertification of Ground-Based Pressure Vessels and Pressurized Systems
- WFF Range Safety Manual (RSM)
- Safety Data Sheets (SDS)

9 QUALITY ASSURANCE

9.1 All operators and OSS participating will print their name below and initial beside their name.

| | | |
|-----------------------|-------------------|---------------|
| _____ Printed Name | _____ Initials | _____ Date |
|-----------------------|-------------------|---------------|

| | | |
|-----------------------|-------------------|---------------|
| _____ Printed Name | _____ Initials | _____ Date |
|-----------------------|-------------------|---------------|

| | | |
|-----------------------|-------------------|---------------|
| _____ Printed Name | _____ Initials | _____ Date |
|-----------------------|-------------------|---------------|

| | | |
|-----------------------|-------------------|---------------|
| _____ Printed Name | _____ Initials | _____ Date |
|-----------------------|-------------------|---------------|

Identify OSS for this work instruction.

| | | |
|-----------------------|-------------------|---------------|
| _____ Printed Name | _____ Initials | _____ Date |
|-----------------------|-------------------|---------------|

- 9.2 Operator will verify that the required procedural steps are accurately performed and complete. To attest that this has been accomplished the operator will initial and date each sign-off indicating satisfactory completion of each step as performed.
- 9.3 Each step shall be signed prior to proceeding to the next step. If it is necessary to perform steps out-of-order, a red line shall be added to the work instruction identifying the steps that were performed out-of-order and the reason for the deviation. Prior to proceeding with the re-sequenced steps, concurrence from the Principal Investigator (PI) and OSS and mission manager must be obtained. If the performed-out-of-order steps are within a section requiring an OSS, OSS approval (initials) of the red line is required prior to proceeding. If the performed-out-of-order steps are in a section that does not require an OSS, the PI, or the mission manager must approve (initial) the redline prior to proceeding. For the non-hazardous section, the OSS can approve the redline at a later time.
- 9.4 If a task is stopped prior to completing the section describing that task, the time, date, and nature of the stoppage (lightning, lack of parts, etc.) shall be noted on the bottom of the step where the stoppage occurred. A note at the bottom of the page shall also describe any steps that were required to put the system into a SAFE condition and any other pertinent information.
- 9.5 Upon re-starting the stopped operation, another note shall be generated indicating when the operation was resumed and the safety precautions performed prior to re-starting the task. Examples of these precautions include (but are not limited to) checkout of GSE, verification of proper PPE, clearance of danger areas, and hazardous operations briefing.
- 9.6 If the work stoppage was in a section requiring an OSS, the OSS must initial the notes describing the nature of the work stoppage and a note before starting a stopped operation.

- 9.7 After completing each section, the technician will sign indicating satisfactory completion of each section. If an OSS was required for the section, the OSS shall also sign at the end of the section indicating successful completion of the section.

Participating personnel (technicians and/or OSS's) are encouraged to note any pertinent information in notes section on the bottom of section 10.0 pages. If additional space is required, the margins or backs of pages can also be used for notes.

10 IMPLEMENTATION

10.1 BITSE Ground Purge Procedure

NOTE

Personnel shall always be kept at the absolute minimum when dealing with hazardous systems.

NOTE

A NASA certified OSS shall be present during all high-pressure set-up operations, Steps 1 through 6.

WARNING

Oxygen sensors necessary to conduct this test and ear protection will be provided if the permissible exposure level exceeds OSHA standards.

WARNING

Nitrogen gas used for testing will displace oxygen: an oxygen sensor shall be located in the room to alarm personnel if the oxygen level becomes depleted unless out of doors.

WARNING

Ensure the direction of any safety relief valve venting is pointed away from workers and work areas.

Verify OSS is present and is aware that the operation is about to begin.

| | | |
|-----------------------|-------------------|---------------|
| _____ Printed Name | _____ Initials | _____ Date |
|-----------------------|-------------------|---------------|

| | | |
|-----------------------|-------------------|---------------|
| _____ Printed Name | _____ Initials | _____ Date |
|-----------------------|-------------------|---------------|

| | | |
|-----------------------|-------------------|---------------|
| _____ Printed Name | _____ Initials | _____ Date |
|-----------------------|-------------------|---------------|

10.1.1 Verify regulator installed on GN2 source.

10.1.2 Verify all hoses leading from regulator to payload inlet connected.

10.1.3 Set regulator output pressure to 0 psi.

10.1.4 Open output valve on nitrogen tank.

10.1.5 Begin flow by setting regulator output pressure to 20-30 psi.

10.1.6 Set flow rate to a minimum of 1slpm (standard liter per minute) using flow meter needle valve.

10.1.7 Stop flow by setting regulator output pressure to 0 psi and closing tank valve.

END OF HAZARDOUS OPERATION

OSS verification of end of hazardous operation.

| | | |
|--------------|----------|-------|
| _____ | _____ | _____ |
| Printed Name | Initials | Date |
| _____ | _____ | _____ |
| Printed Name | Initials | Date |
| _____ | _____ | _____ |
| Printed Name | Initials | Date |

10.2 BITSE Launch Pad Purge Procedure

NOTE

Personnel shall always be kept at the absolute minimum when dealing with hazardous systems.

NOTE

A NASA certified OSS shall be present during all high-pressure set-up operations, Steps 1 through 6.

WARNING

Oxygen sensors necessary to conduct this test and ear protection will be provided if the permissible exposure level exceeds OSHA standards.

WARNING

Nitrogen gas used for testing will displace oxygen: an oxygen sensor shall be located in the room to alarm personnel if the oxygen level becomes depleted unless out of doors.

WARNING

Ensure the direction of any safety relief valve venting is pointed away from workers and work areas.

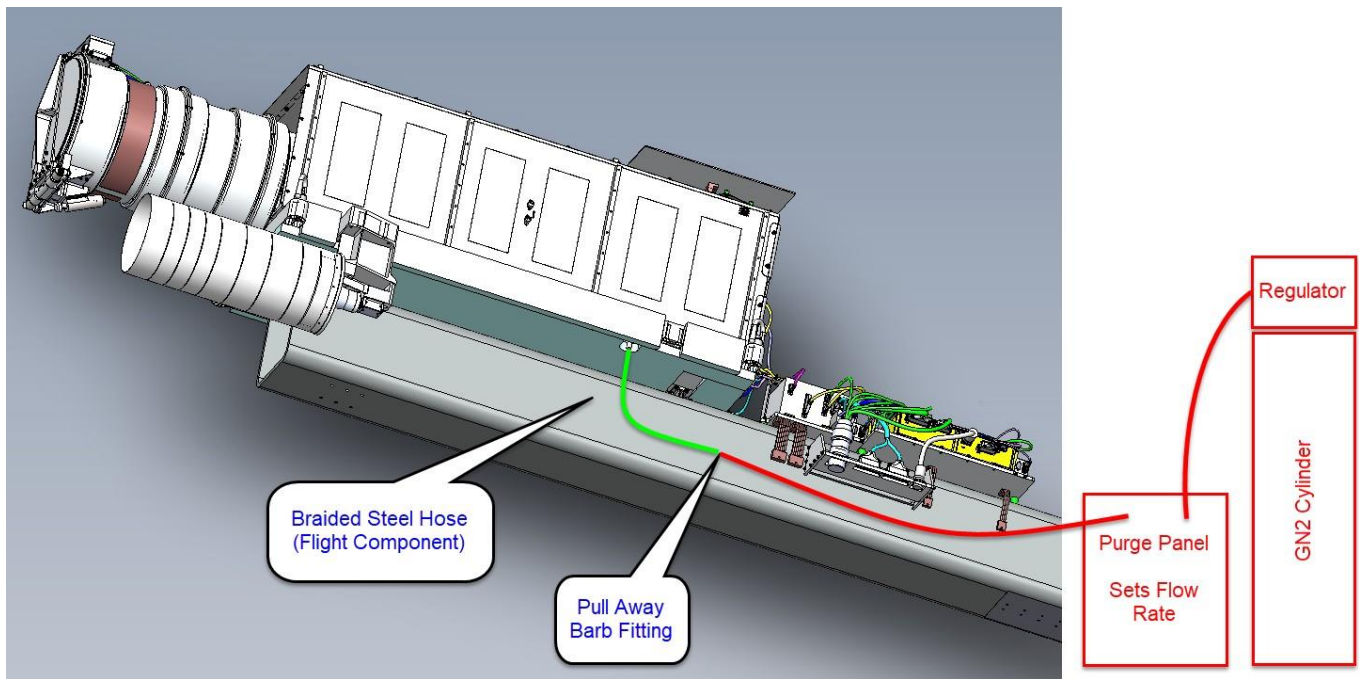
Verify OSS is present and is aware that the operation is about to begin.

| | | |
|--------------|----------|-------|
| _____ | _____ | _____ |
| Printed Name | Initials | Date |
| _____ | _____ | _____ |
| Printed Name | Initials | Date |
| _____ | _____ | _____ |

- ## END OF HAZARDOUS OPERATION

| | | |
|--------------|----------|------|
| Printed Name | Initials | Date |
| Printed Name | Initials | Date |
| Printed Name | Initials | Date |

Attachment 1 – BITSE Launch Pad Purge Procedure Diagram



| Item | Part Number | Maximum Pressure |
|---------------------------------------|--|--|
| Regulator | Airgas UHP Regulator Y12C445D580-AG | Inlet: 4000 psi Outlet: 0-100 psi regulated |
| Purge Panel | High Purity Systems Inc. Part #703-330-5094 | Inlet Max. Pressure = 150 PSI |
| 1/2" braided metal hose | McMaster Carr #5793K61 | 1,800 psi |
| 1/4" NPT Check Valve Valve | McMaster Carr #7768K220 | 500 psi |
| 1/4" NPT 90 deg elbow | McMaster Carr #4452K472 | 150 psi |
| 1/4" OD Tygon 2475 High Purity Tubing | US Plastics #57577 | 50 psi |
| 1/8" Barbed Fitting | McMaster Carr #5361k81 | 150 psi |